In-Situ Monitoring of Cold Cap/Melt Utilizing X-ray Computed Tomography

PARTNERS

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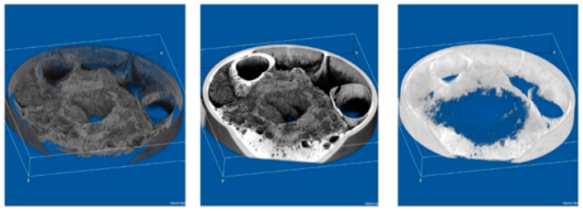

A laboratory-scale melter crucible imaged with X-ray CT, showing the cold cap (dark phase) and glass (light phase).

Technical Summary

Variables controlling bubble formation and foam layers within the cold cap, a reacting layer of feed over a molten pool of glass, can have critical impact on melt-rate and melter operations due to their influence on heat transfer. As the site of the reactions causing bubbles and foaming, the cold cap is recognized as an important subject of study. However, real-time observation of exactly what happens in the cold cap has never been achieved. Present X-ray CT studies of reacting pellets, dried feed pressed into a cylinder, show this technology can be employed at a scale that provides exact imagery of feed reactions. Real-time imaging of a melter will define how bubbles and cavities are formed, and how the boiling slurry pool is affected by the surrounding cold cap.

Path Forward

- Design and fabricate a system that will be able to melt glass while performing X-ray CT imaging in a small melter.
- Train individual(s) at Tokyo Institute of Technology to operate X-ray CT system and process the images.
- Evaluate the X-ray CT images to determine the condensed phase versus void fraction.
- Apply values from computational analysis to modeling effort used to evaluate the melt pool within a prototypic nuclear waste melter system.

Key Accomplishments

- Imaged seven Hanford feed compositions in pellet form at Tokyo Institute of Technology using X-ray CT system.
- Analyzed images to determine void fraction.
- Produced peer reviewed publication "X-ray Tomography of Feed-to-Glass Transition of Simulated Borosilicate Waste Glasses" by W. H. Harris, D. P. Guillen, J. Klouzek, R. Pokorny, T. Yano, S. Lee, M. J. Schweiger and P. Hrma was accepted by the Journal of American Ceramic Society

Key Benefits

- Determined usefulness of technology for in-situ imaging for evaluating melting within the Waste Treatment Plant at Hanford.
- Initial data will be incorporated into a melter model which evaluates the cold cap that is formed as glass is processed within the melter.
- Enable accurate description(s) of what is happening "real-time" within the melter to develop predictive tools to increase glass out-put for DOE nuclear waste glass melters.

For more information on this project or the EM International Program

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